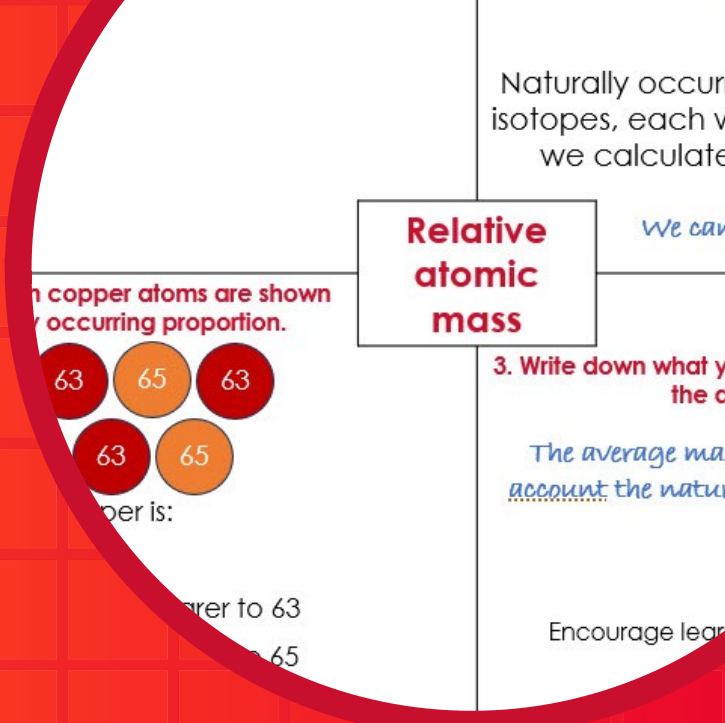
14–16 years

Quantitative chemistry: Frayer models



ROYAL SOCIETY OF CHEMISTRY

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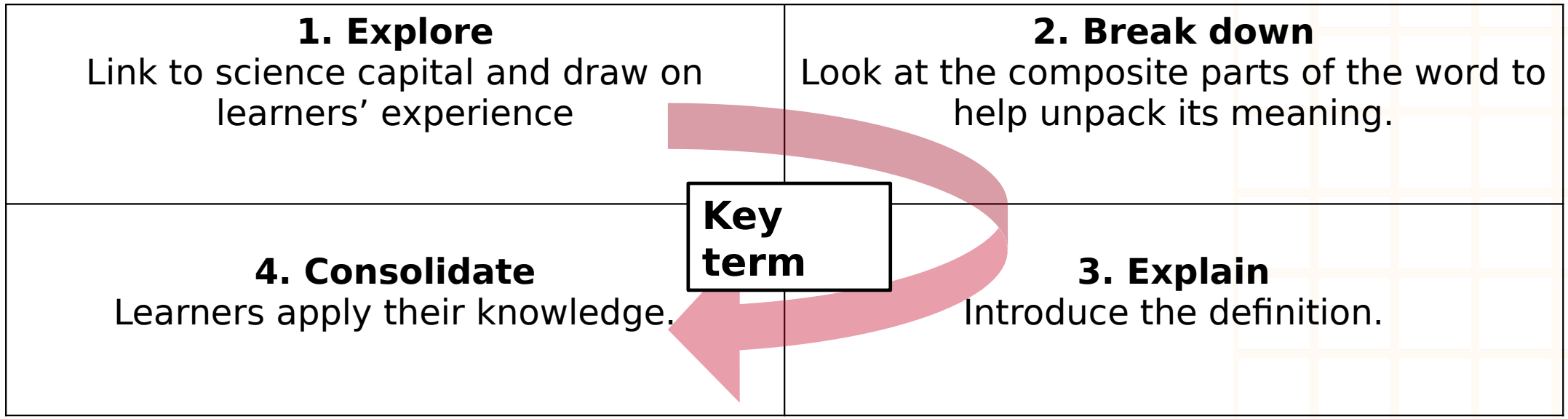
Frayer models

Frayer models are a simple but effective way to develop learners' understanding of a new piece of vocabulary. You will see what your learners already know and identify any misconceptions they have.

There are four stages learners can work through, but you can adapt this model to best suit your learners. You can guide learners through all quadrants, but particularly quadrant 2 works best as a teacher-led discussion. Quadrant 3 might also need/benefit from some discussion.


1. Explore
Link to science capital and draw on learners' experience
2. Break down
Look at the composite parts of the word to help unpack its meaning.
Key term
4. Consolidate
Learners apply their knowledge.
3. Explain
Introduce the definition.

Find more guidance including tips, adaptations and further reading, in the teacher notes: rsc.li/3Gi9HHN_

Balanced symbol equation

1. What does the term ‘balanced symbol equation’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down the term ‘balanced symbol equation’.

‘Balanced’ suggests that something is the same on both sides – what is the same?

How is the word ‘equation’ used differently in maths and chemistry?

3. Write down what you think the term ‘balanced symbol equation’ means.

4. Here is a word equation for the complete combustion of methane. Arrange the chemical formulas given below to construct a balanced symbol equation for the reaction.

methane + oxygen → carbon dioxide + water

CO_2 H_2O CH_4 O_2

(There is no need to include state symbols.)

Compare what you wrote with the definition (slide 7).

1. What does the the term ‘relative atomic mass’ mean to you? Where have you come across this word (or parts of this word) before?

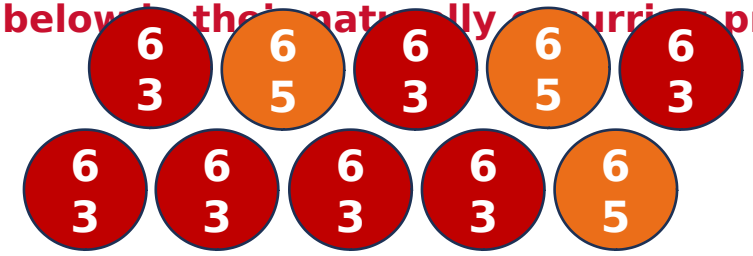
2. Break down the term ‘relative atomic mass’

What does the adjective ‘relative’ mean?

Naturally occurring elements usually contain several isotopes, each with a slightly different mass. How can we calculate just one mass to represent all the isotopes?

Relative atomic mass

4. The relative masses of ten copper atoms are shown below in their naturally occurring proportion.



The relative atomic mass of copper is:

A less than 65.

B in between 63 and 65, but nearer to 63.

C in between 63 and 65, but nearer to 65.

D more than 65.

3. Write down what you think ‘relative atomic mass’ means.

Compare what you wrote with the definition (slide 8).

1. What does the term ‘amount of substance’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down ‘amount of substance’

amount

substance

Amount of substance

4. Circle the description that could describe th amount of helium in the balloon.

A It contains 0.4 g of helium.

B It has a volume of 2.4 dm^3.

C It contains 0.1 mol of helium.

D All three descriptions above.

rite down what you the term ‘amount of substance’ means.

Compare what you wrote with the definition (slide 9).

1. What does the term ‘percentage yield’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down ‘percentage yield’.

percentage

yield

Percentage yield

4. Use the words to fill in the blanks to show t type of yield being described at each stage

percentage actual theoretical

A student made some crystals of hydrated copper(II) sulfate by neutralising 0.016 mol of dilute sulfuric acid. From this amount of acid, her _____ yield was 4.0 g of crystals, but when she weighed her crystals, she found that her _____ yield was only 2.8 g. From this, she calculated that her _____

3. Write down what you think the term ‘percentage yield’ means.

Compare what you wrote with the definition (slide 10).

1. What does the term ‘balanced symbol equation’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down the term ‘balanced symbol equation’.

‘Balanced’ suggests that something is the same on both sides – what is the same?

The total number of atoms of each element and also the total mass.

How is the word ‘equation’ used differently in maths and chemistry? **In maths, it is an expression or formula with an ‘=‘ sign showing how different quantities are related. In chemistry it shows the chemical formulas**

e

reactants and products

ated by an arrow.

Balanced symbol equation

4. Here is a word equation for the complete combustion of methane. Arrange the chemical formulas given below to construct a balanced symbol equation for the reaction.

methane + oxygen → carbon dioxide + water

CH_4 CO_2 + $2O_2$ H_2O → CH_4 O^2 CO_2 + $2H_2O$

2

3. Write down what you think the term ‘balanced symbol equation’ means (below is the definition from the key terms list).

For a chemical reaction this shows the chemical formulas of the reactants and products separated by an arrow. Whole numbers may be written before the formulas to balance the equation.

Relative atomic mass

1. What does the the term ‘relative atomic mass’ mean to you? Where have you come across this word (or parts of this word) before?

2. Break down the term ‘relative atomic mass’.

What does the adjective ‘relative’ mean?

One thing compared to something else. In this case atomic masses are compared to the approximate mass of a proton or neutron.

Naturally occurring elements usually contain several isotopes, each with a slightly different mass. How can we calculate just one mass to represent all the isotopes?

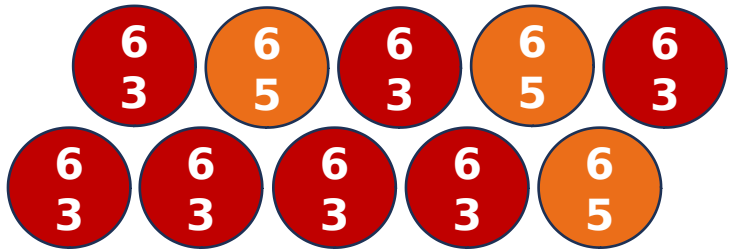
We can work out the average mass of an atom.

3. Write down what you think ‘relative atomic mass’ means (below is the definition from the key terms list).

The average mass of an atom of an element taking into account the naturally occurring percentages of its isotopes.

Encourage learners to compare their attempted definition with this one.

4. The relative masses of ten copper atoms are below in their naturally occurring proport



The relative atomic mass of copper is:

A less than 65.

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C in between 63 and 65, but nearer to 65.

D more than 65.

1. What does the term ‘amount of substance’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down ‘amount of substance’.

amount

From the Middle English verb ‘amounten’ meaning to increase or add up to. Today it generally refers to the quantity of something.

substance

From Middle English it was first used to describe the essence of something. In chemistry it is used to refer to a particular solid, liquid or gas.

Amount of substance

4. Circle the description that could describe th amount of helium in the balloon.

A It contains 0.4 g of helium.

B It has a volume of 2.4 dm^3.

C It contains 0.1 mol of helium.

D All three descriptions above.

Write down what you think the term ‘amount of ance’ means (below is the definition from the key terms list).

How many atoms, molecules or formula units are present in a sample of the substance, measured in moles (mol).

Encourage learners to compare their attempted definition with this one.

1. What does the term ‘percentage yield’ mean to you? Where have you come across this term (or parts of this term) before?

2. Break down ‘percentage yield’.

percentage

From the Latin ‘percentum’ meaning ‘by the hundred’.
It is a way of expressing the proportion of a whole in terms of hundredths.

yield

From the Anglo-Saxon ‘geldan’ meaning the idea of a reward or pay that is given. Today, the noun ‘yield’ refers to what you produce.

Percentage yield

4. Use the words to fill in the blanks to show t type of yield being described at each stage.

percentage actual theoretical

A student made some crystals of hydrated copper(II) sulfate by neutralising 0.016 mol of dilute sulfuric acid. From this amount of acid, her _**theoretical**_ yield was 4.0 g of crystals, but when she weighed her crystals, she found that her _____**actual**_ yield was only 2.8 g. From this, she calculated that her__**percentage**_ yield was 70%.

3. Write down what you think the term ‘percentage yield’ means (below is the definition from the key terms list).

The actual mass or amount of product, given as a percentage of the theoretical mass or amount of product you could make in a chemical reaction if no other reactions take place and nothing is lost.

Encourage learners to compare their attempted definition with this one.

Example layout

1. Explore

Link to science capital and draw on learners' experience.

2. Break down/'what do we know about X'?

Look at composite parts of the word to help unpack its meaning.

Or invite learners to suggest what, as a class, they already know about the key term (with the help of a few bullet points).

Select your key term

4. Consolidate

Learners apply their knowledge.

3. Explain

Introduce the definition.